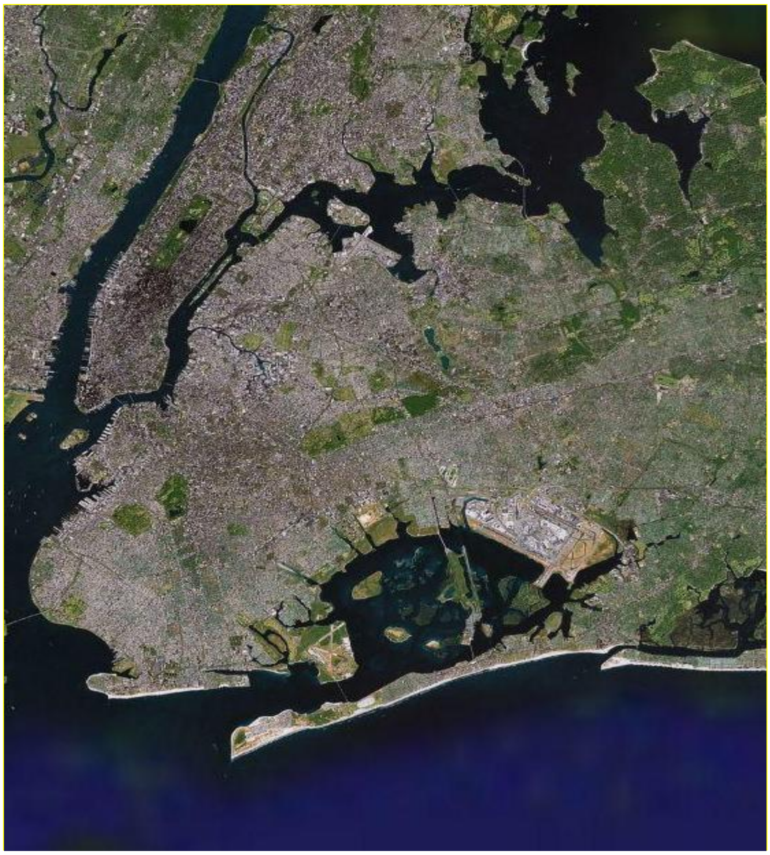
New York City Department of Environmental Protection

Capital Project No. WP-169

CSO Long Term Control Plan II



Comprehensive Field Sampling and Analysis Plan

for the

Combined Sewer Overflow Long Term Control Plan Program

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1 Introduction

This Comprehensive Field Sampling Analysis Plan (FSAP) was developed by AECOM for the New York City (NYC) Department of Environmental Protection (DEP) under the Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) II contract. This FSAP establishes the overarching objectives of the sampling program and provides standardized sample collection and quality review protocols for the sampling efforts that may be conducted under waterbody-specific FSAPs. Waterbody-specific FSAPs will be submitted to DEP as attachments to the present Comprehensive FSAP for each of the LTCP waterbodies listed below:

1. Alley Creek (sample collection completed)
2. Westchester Creek
3. Hutchinson Creek
4. Flushing Creek
5. Bronx River
6. Gowanus Canal
7. Coney Island
8. Jamaica Tributaries and Bay
9. Flushing Bay
10. Newtown Creek
11. Citywide

The waterbody-specific FSAPs will provide information on the sampling scope and locations that have been selected for the waterbody. LTCP II sampling effort for each waterbody will provide additional water quality data to the existing ambient water quality monitoring program (DEP's Harbor Survey and PCM monitoring). In the event that sampling and/or required analyses are not covered in this Comprehensive FSAP, the necessary protocol and/or method will be included in the waterbody-specific attachments.

2 Scope of Sampling and Analysis

The following list presents the range of sampling efforts covered under this Comprehensive FSAP. As described, the data collected through the FSAP will support the water quality assessment portion of the LTCP development process, primarily to understand the impacts of CSO discharges on a waterbody through refinement of the corresponding Receiving Water Quality Models and Collection System Models (InfoWorks). In some instances, the data collected may enhance the understanding of relative impacts of stormwater and CSO discharges on water quality. The sampling efforts that will be conducted for each waterbody will be based on site specific considerations, such as available data, access considerations, associated infrastructure and safety.

1. Open Water

a. Surface Water Wet and Dry Weather Sampling: This sampling will provide data on parameters such as bacteria, chlorophyll-a, dissolved oxygen (DO) concentrations, temperature, salinity and conductivity in the waterbody during both wet and dry weather conditions for use in the Receiving Water Quality Model for the waterbody, to supplement the long term Harbor Survey data, where available, and to characterize the current waterbody conditions Dry weather data may also be used to identify impacts of dry weather sources on the receiving water quality at specific locations.

b. Diurnal Monitoring: In some instances, continuous monitoring for DO, temperature, conductivity/salinity and algae will be conducted with data sondes to provide additional data for use in refining the Receiving Water Quality Model for the waterbody, to supplement the long term Harbor Survey data, where available, and to characterize the current waterbody conditions.

c. Sediment Oxygen Demand (SOD): SOD analysis will provide additional data for use in refining the Receiving Water Quality Model of the waterbody and enhance analysis of DO levels through refinement of the sediment/water column transfer relationships.

2. Combined Sewer Overflow

a. CSO Effluent Sampling: This sampling will provide data on concentrations of bacteria, total suspended solids (TSS) and oxygen demand resulting from CSO discharges, supporting the estimation of the CSO loadings to the receiving waterbody.

b. CSO Discharge Flow Measurement: Continuous flow measurements will provide the necessary quantification of CSO discharges that, in association with measured effluent quality parameters, will enable the estimation of the CSO loadings to the receiving waterbody.

3. Stormwater

a. Stormwater Effluent Sampling: This sampling will provide data on concentrations of bacteria, TSS and oxygen demand resulting from stormwater discharges, supporting the estimation of the stormwater loadings to the receiving waterbody.

b. Stormwater Flow Measurement: Continuous flow measurements will allow the estimation of stormwater discharges that, in association with measured effluent quality parameters, will enable the estimation of the stormwater loadings to the receiving waterbody.

4. Sanitary Sewer

a. This sampling will provide data on bacteria concentrations under dry weather conditions in sanitary sewage at locations upstream of where CSO discharge sampling is being conducted.

3 Sampling Program Organization and Overview

This section presents templates for standard information that will be provided in each waterbody-specific FSAP, including the organization of the sampling team; the sampling and analyses selected for the waterbody; and the relevant figures, schematics and tables.

3.1 *Project Team Organization*

A table will be presented for each waterbody that will identify the key project team and field sampling staff, including their roles in executing the FSAP. An example is provided in Table 1. For the majority of waterbodies, only the LTCP Leader will change.

Table 1. Example FSAP Team Organization

Title	Staff Name (Firm Name)	Role
Project Manager	Peter Young (H&S)	Responsible for overall project management as described in the contract.
LTCP Leader	*TBD*	Leader of LTCP development for *Waterbody Name*.
Sampling Program Manager	Helder de Almeida (AECOM)	Responsible for coordinating and scheduling project activities, and implementing the terms and conditions of this sampling work, including coordination with analytical laboratories.
Field Leader	Yuliya Vaschuk (NOVA)	Responsible for day-to-day activities in the field. The Field Leader will maintain the site logbook, the official record of daily site activities, and serve as the on-site management reporting to the Sampling Program Manager. The Field Leader will provide a written summary of events to the Sampling Program Manager after each sampling event.
Field Sampling Team	Various staff (AECOM, NOVA, Savin, HDR, Aqua Survey, Flow Assessment, ADS)	Conduct sample collection, handling and preparation under direction from the Sampling Program Manager and Field Leader and as required by the FSAP, HASP and related documents.
Analytical Laboratories	QC Labs Source Molecular HDR	Provide analytical services per the contracted scope of work and in accordance with applicable methods and quality protocols.

3.2 *Sampling Program Overview*

Table 2 provides an example summary overview table that will indicate the sampling efforts selected for a subject waterbody. Where possible, the coordinates for the sample stations of the sampling efforts listed above will coincide.

Table 2. Example Sampling Program Summary

Condition	Sampling Objective	Waterbody FSAP[1]
Surface Water Sampling	Wet and Dry Weather Bacteria	
	Diurnal Monitoring	
	Sediment Oxygen Demand	
	Chlorophyll-a	
CSO	Discharge Sampling	
	Discharge Flow Measurement	
Stormwater	Discharge Sampling	
	Discharge Flow Measurement	
Sanitary Sewer	Dry Weather Concentrations	

Notes:
1. An "x" will indicate the sampling effort that will be performed for the subject waterbody.

3.3 *Sampling Parameters and Field Measurements*

Table 3 provides a complete list of the analytical laboratories and parameters that may be analyzed for a given FSAP. As stated in Section 2, analysis of open water samples will target bacteria (fecal coliform and enterococci). Open water sampling may also include selective sampling for Chlorophyll-a and SOD. CSO and stormwater samples will target bacteria, TSS and Five-day Biochemical Oxygen Demand (BOD5).

Table 3. FSAP Analytical Laboratories

Laboratory	Parameter	Method	Sample Holding Time
QC Laboratories	Fecal coliform bacteria	SM9222D	8 hours
	Enterococci	EPA 1600	8 hours
	Chlorophyll-a	EPA 446	7 days
	Total Suspended Solids (TSS)	SM2540D	7 days
	5-day Biochemical Oxygen Demand (BOD5)	SM5210B	48 hours
HDR	Sediment Oxygen Demand (SOD)	-	-

QC Laboratories is a New York State Department of Health-certified Environmental Laboratory Approval Program (ELAP) analytical laboratory. The quality control/quality assurance (QA/QC) protocols for the laboratories are provided in this Comprehensive FSAP, unless otherwise noted, in Section 7.

Table 4 provides the range of field water quality measurements that may be recorded during a sampling effort. Receiving waters measurements will be collected using a calibrated YSI 650 MDS data logger and YSI 600QS data sonde, or similar models; CSO and stormwater effluents will be measured using YSI Pro 2030.

Table 4. FSAP Field Measurements

Parameter	Unit of Measurement
Temperature	Degrees Celsius (°C)
Conductivity	Millisiemens per Cubic Centimeter (mS/cm^3)
Salinity	Parts per thousand (ppt)
Dissolved Oxygen (DO)	Percent (%)
DO	Milligrams per Liter (mg/L)

The specific sampling objectives and existing data available for each waterbody-specific FSAP (e.g. surface water wet weather sampling) will determine the appropriate parameters and field measurements.

3.4 *Standard Figures*

Each waterbody-specific FSAP will have standard figures:

1. Aerial view of the waterbody identifying relevant features and infrastructure (e.g. fresh water sources, CSO outfalls, etc.)
2. Aerial view of the waterbody identifying the approximate locations of open water sample stations (e.g. surface water wet and dry weather samples, SOD, etc.).

Additional figures will be included, as needed, to describe or identify a sampling objective or locations (e.g. schematic of a CSO retention tank that will be sampled, schematic of an outfall discharge sampling location, etc.).

3.5 *Standard Tables*

For each waterbody-specific FSAP, tables based on the templates in Table 5, Table 6, and Table 7 will be provided to summarize the scope of the sampling effort. The table will enable the Sampling Program Manager to estimate necessary sampling supplies and budget and will provide a clear plan to the Field Sampling Team in preparation of a sampling event.

Table 5. Example FSAP Overview Table

Sampling Effort / Element	Surface Water Bacteria		Surface Water Chlorophyll-a		Surface Water SOD		Sanitary Sewer		CSO Discharge		Stormwater Discharge	
	Wet Weather Sampling	Dry Weather Sampling	Wet Weather Sampling	Dry Weather Sampling	Wet Weather Sampling	Dry Weather Sampling	Wet Weather Sampling	Dry Weather Sampling	Wet Weather Sampling	Dry Weather Sampling	Wet Weather Sampling	Dry Weather Sampling
Number of Events												
Number of Sample Locations												
Duration (consecutive days)												
Sample Collection Frequency (times per day)												
Target Collection Depths per Sample Location												
Estimated Total Number of Samples												

Table 6. Example Flow Monitoring Summary Table

Flow Measurement / Element	CSO Discharge	Stormwater Discharge	Open Channel
Number of Locations			
Frequency			
Duration			

Table 7. Example FSAP Analysis and Field Measurements Table

Sampling Effort / Analysis and Field Measurements	Surface Water		Sanitary Sewer		CSO Discharge		Stormwater Discharge	
	Wet Weather Samples	Dry Weather Samples	Wet Weather Samples	Dry Weather Samples	Wet Weather Samples	Dry Weather Samples	Wet Weather Samples	Dry Weather Samples
Fecal coliform								
Enterococci								
Chlorophyll-a[1]								
TSS								
BOD5								
SOD[1]								
Temperature								
Conductivity								
Salinity								
DO								

Notes:

1. *The sample collection dates and locations for SOD and Chlorophyll-a may not coincide with the dates and locations of sample collection for fecal coliform and enterococci.*
2. *Sanitary Sewer sampling will only be conducted in dry weather; a column for wet weather samples has been included for continuity in the summary table.*
3. *CSO Discharges sampling will only be conducted in wet weather; a column for dry weather samples has been included for continuity in the summary table.*

4 Open Water

4.1 *Surface Water Wet and Dry Weather Sampling*

4.1.1 Overview

Surface water samples will be collected from a waterbody during both wet and dry weather conditions at a predetermined number of open water ("OW") sampling stations. The stations will be assigned a unique station identification (ID) (e.g. OW1, OW2, etc.). A figure in the waterbody-specific FSAP will provide the approximate location for each sampling station. During the first field sampling effort, the station location will be established and recorded using Global Positioning System (GPS). All future sampling efforts will seek to use the established coordinates to identify the correct station location.

There will be a predetermined amount of distinct wet and dry weather sampling events. Dry weather sampling will last one day and will not be conducted within 72 hours of the end of a prior rainfall event.

The sampling team will prepare to mobilize for wet weather sampling based on a forecast for rain. A wet weather sampling event is defined as a rain event that results in a CSO discharge to the receiving waterbody. When the sampling team has successfully collected CSO discharge samples (Section 5.1), the surface water wet weather sampling will commence the following day, with a total duration of three days. The purpose of this sampling approach is to collect information for pathogens when the maximum concentrations will be present (during rainfall). By sampling for a period of three days after a rain event, data can be collected to define the reduction in pathogens from the peak value. Generally, pathogens die-off at a first order decay rate of about 1.5/day at 20 degrees Celsius. Added to that is the additional reductions associated with mixing and tidal exchange. This generally increases the approximate disappearance rate to an equivalent of about 2/day. Therefore at the end of the third day, the peak pathogen concentrations are expected to be reduced to about 0.25% of the peak concentration. For example. if the fecal coliform concentration in a water body was 100,000 #/100mL during rainfall, it would be reduced to about 250 #/100mL after three days. By collecting this information, we are able to test the ability of the water quality model to reproduce both the decay and dilution and assess whether the model is reproducing this large change.

The rainfall total, intensity and duration of each wet weather event will be included in analysis and presentation of the data. Rainfall data will be obtained from the nearest rainfall gage available. The same methodology will be used to collect dry-weather and wet-weather samples:

- All samples will be grab samples.
- Samples will be collected at two depths for each station, wherever feasible.

- Water quality measurements (DO, temperature and conductivity/salinity) will be recorded for each sample station and sample depth using portable YSI meter.
- The Kemmerer sampler cable will be attached to a nylon rope marked in two-foot increments in order to best determine the sampling depth at each strata and location. A portion of the sample collected by the Kemmerer sampler will be used for water quality instant measurements as well as applicable sample collection.
- During each day of a sampling event, samples will be collected two times in order to capture ebbing and flooding conditions.
- Due to the eight hour holding time limit for samples collected for bacteria analysis, the laboratory will retrieve the samples two times during each sampling day (e.g. following sampling during ebbing conditions and then following sampling during flooding conditions).
- Where possible, samples will be collected from the stations sequentially in one direction for high tide and sequentially in the opposite direction for low tide.

4.1.2 Surface Water Wet and Dry Weather Sample Collection Protocol

Surface water samples may be collected from a boat or land depending on access considerations related to water depth, fixed bridges, etc. The same protocol will be followed to collect samples and conduct water quality measurements for either method of sample collection:

1. Calibrate the portable YSI water quality meter prior to initiating the sampling event.
2. Position the boat at the coordinates of the sample stations that were established with GPS.
3. At each station, record time of day, weather conditions, and general tidal phase (high/low slack, ebb, and flood) in the field logbook.
4. Put on disposable gloves to prevent cross-contamination.
5. Rinse Kemmerer with site water prior to collection of each sample to avoid cross contamination. A minimum of three complete fill and empty cycles is considered an adequate rinse procedure. If there are signs of solids or other contamination on the Kemmerer bottle, such contamination will be cleaned prior to the rinse procedure.
6. Deploy Kemmerer sampler to desired water depth and record sampling depth. Where field measurements of water depth are 5-feet or more, collect samples at 2-feet below surface and at 2-feet above the bottom; where water depths are less than 5-feet, collect sample from a single depth midway between the surface and bottom.

7. Collect water sample and fill laboratory supplied sterile sample bottles.
8. For each sample collected, fill multi-parameter meter with the Kemmerer sampler content and record DO, temperature, and conductivity/salinity.
9. Place sample containers in insulated coolers containing ice and proceed to the next sampling location.
10. Repeat the above procedure for each sampling location and depth.
11. When sampling is complete and the boat has returned to the dock, place additional ice in the insulated coolers as needed to maintain sample temperature at 4°C.
12. Fill out the appropriate chain of custody sheets and deliver the coolers to the laboratory via a courier (who will confirm delivery date/time within the sample holding time).

4.2 *Diurnal Monitoring - Sondes*

Continuous recording data sondes may be installed to record diurnal variations of DO, temperature, conductivity/salinity and algae. The locations of sondes will be included in the figure showing all surface water samples. The YSI 6 – Series Multiparameter Sondes and Sensors will most likely be selected for monitoring under LTCP. Two sondes will be installed in each waterbody. The sondes will monitor the above mentioned parameters for a period of 30 days in order to capture one complete lunar cycle.

4.3 *Sediment Oxygen Demand*

The SOD sample stations will seek to approximately match a subset of the wet and dry weather surface water sampling locations and will be included in the figure showing surface water samples. SOD sampling will focus on a predetermined amount of wet weather and dry weather events that may not always coincide with wet and dry weather water column samples described previously. The sampling and analytical protocol for SOD is detailed in Attachment A.

4.4 *Open Water Flow Measurement*

Acoustic Doppler Current Profiling (ADCP) instrumentation will be used to measure water velocity of the rivers or creeks at selected waterbodies. An ADCP is a hydroacoustic current meter similar to a sonar, attempting to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column. Up to two ADCPs may be installed in each waterbody. The ADCPs will be installed for a period of 30 days in order to capture one complete lunar cycle. When used, the locations of the ADCPs will seek to coincide with those of the data sondes (Section 4.2).

5 Combined Sewer Overflow

5.1 *CSO Discharge Sampling*

The majority of CSO discharge samples will be collected via a manhole at a point between the CSO outfall and the regulator in order to collect a sample that represents the discharge from the outfall. If there is interference resulting from tidal flow, the sample location may be moved upstream within the conveyance system. For some waterbodies, samples will be collected at different points in a CSO retention tank facility. In these instances the waterbody-specific FSAP will provide the sample collection methodology. The sampling stations for each waterbody-specific FSAP will be assigned a unique station ID and a figure or schematic will provide the approximate locations of each sample station.

CSO discharge samples will be collected during a predetermined number of wet weather events. Sampling locations will be monitored to capture a first flush of CSO discharge. Five samples will be manually collected every thirty minutes (0-minutes; 30-minutes; 60-minutes; 90-minutes and 120-minutes) for a maximum of two hours during the wet weather event.

The following methodology will be used to collect CSO samples via manhole:

- Samples will be manually collected grab samples.
- Samples will be collected at a target depth of two to six inches below the water surface (related to the depth of flow in the conduit). If the flow of water depth does not permit, the sample will be collected from the water surface. Record the depth the sample was taken in the field logbook
- Water quality measurements (DO, temperature and conductivity/salinity) will be recorded for each sample station and sample depth using portable YSI meter.
- The water quality meter will be calibrated prior to the beginning of the sampling event.
- For sampling stations around CSO facilities, such as retention tanks, there may be wet weather events that do not result in a CSO discharge to the waterbody. On these occasions, samples of the influent will continue to be collected and analyzed upstream of the retention facility.

5.1.1 CSO Sample Collection Protocol

Once in position to collect the sample, the following sampling protocol will be adhered to:

1. Calibrate the water quality meter prior to initiating the sampling event.
2. Record time of day, weather conditions, and water depth in the field logbook.
3. Put on disposable gloves to prevent cross-contamination.

4. Using laboratory supplied sterile sample bottles, collect a sample two to six inches below the water surface, if water depth allows. Otherwise, collect a sample from the water surface. Fill laboratory supplied sterile sample bottles. Record the depth the sample was taken in the field logbook.
5. For each sample collected, deploy multi-parameter meter and record DO, temperature, and conductivity/salinity.
6. Place all sample containers in insulated coolers and proceed to the next sampling location.
7. Repeat the above procedure for each sampling location.
8. When sampling is complete, place additional ice in the insulated coolers as needed to maintain sample temperature at 4°C.
9. Fill out the appropriate chain of custody sheets and deliver the coolers to the laboratory via a courier (who will confirm delivery date/time within the sample holding time).

5.2 *CSO Discharge Flow Measurement*

CSO discharge flow data may be collected at CSO outfalls and at other CSO-related infrastructure, such as retention tank facilities. DEP has ongoing flow data collection programs that can supplement the LTCP FSAP. Each waterbody-specific FSAP will provide detail on the entity conducting this work and the locations.

5.2.1 Flow Measurement Protocol

CSO overflow data will be calculated using a combination of meter and sensor readings. Near real-time calculations will be performed automatically. Final overflow data will be reviewed and analyzed by the flow metering services provider using the automated data as the baseline and then using human review to fine tune and refine in order to provide more valid information. Specifics on flow monitoring methods will be provided in the waterbody-specific FSAP, given the multitude of flow monitoring schemes possible.

6 Stormwater

6.1 *Stormwater Outfall Sampling*

In some instances, stormwater outfalls will be sampled. The stormwater outfalls that discharge to the waterbody will be examined to identify the best representative location for stormwater sampling. Some stormwater outfalls cannot be effectively sampled due to tidal influence and logistical constraints (traffic requirements, accessibility, etc.). These considerations will be noted in the waterbody-specific FSAP.

6.1.1 Stormwater Sample Collection Protocol

The stormwater sampling follows the same sample collection protocol as CSO sampling (Section 5.1.1). Additionally, if the storm duration does not allow the collection of five samples within a period of two hours (0-minutes; 30-minutes; 60-minutes; 90-minutes and 120-minutes) immediately after the start of overland runoff, the samples collected will be discarded.

6.2 *Discharge Flow Measurement*

Stormwater continuous flow measurements, taken concurrently with sample collection, are required for the estimation of stormwater loadings. Whenever possible, continuous flow metering at locations with known drainage area is preferable.

6.2.1 Flow Measurement Protocol

Stormwater overflow data will be calculated using a combination of meter and sensor readings. Near real-time calculations will be performed automatically. Final overflow data will be reviewed and analyzed by the flow metering services provider using the automated data as the baseline and then using human review to fine tune and refine in order to provide more valid information. Specifics on flow monitoring methods will be provided in the waterbody-specific FSAP, given the multitude of flow monitoring schemes possible.

7 Sanitary Sewer

7.1 *Sanitary Sewer Sampling*

This sampling will seek to characterize the sanitary component of specific CSO outfalls, as selected in the waterbody0specific FSAPs for CSO characterization purposes. Currently, the approach to developing CSO overflow locations is to perform a mass balance, using the InfoWorks model, between the dry weather sewage in the combined sewers and the runoff entering the combined sewers. This mass balance calculation is now being performed using dry weather treatment plant influent sewage samples collected over ten years ago. Because of water conservation changes and the potential for local difference between the outfalls and the WWTP influent headworks, samples will be collected closer to the actual combined sewers.

Up to ten samples will be collected for analysis for fecal coliform and enterococci bacteria to characterize the dry weather sewage concentrations. The sanitary sewer sampling will follow the same sample collection protocol as CSO sampling (Section 5.1.1). This sampling will not be conducted within 24 hours after a rain event.

8 Quality Assurance and Quality Control

8.1 *Sampling Oversight*

Prior to commencing field-based activities, a FSAP kickoff meeting will take place. The kick-off meeting will be led by the Sampling Program Manager with assistance from the Field Leader; each member of the Field Sampling Team will participate. The objective of the kick-off meeting is to provide an overview of the waterbody and sampling objectives and to review the FSAP in detail to ensure that the protocols are successfully executed in the field.

In order to confirm that field sampling, field analysis and laboratory activities are occurring as planned, the Sampling Program Manager, Field Leader and field staff will coordinate after the first sampling event to discuss the methods being employed and to review the quality assurance samples and take any necessary corrective action.

8.2 *Sample Collection Documentation & Custody*

Information generated in the field will be recorded in a field log. A sample field log is provided in Attachment B This will include station identification, present conditions and field observations:

- Date and time of arrival on-site
- Names of the participating Field Sampling Team
- Weather conditions
- Problems or unusual occurrences
- Environmental Health and Safety items or issues

Field data will be recorded on standard field data sheets and transferred to Excel data files, which will be transferred to the Sampling Program Manager.

All analytical laboratories provide coolers, sample bottles and chain of custody (COC) forms for the relevant analysis. Example COCs for each laboratory is provided in Attachment C. The COCs include:

- Date and time of sampling
- Sample location
- The sample ID
- Sample description (this will include an indication of whether the sample represents a “wet” or “dry” weather sample.

- Additional notes or comments
- Signatures of people involved in the COC
- Dates of possession of each person in the COC

The COC will accompany the sample to the laboratory. If the sample(s) must be shipped to a laboratory and the shipping agent refuses to sign or separately carry the COC, it is permissible to put the COC into the box with the sample and then seal the box. The recipient of the box, the laboratory's sample custodian, can then attest to the box's arrival still sealed and unopened.

Accompanying the COC, or included in it, will be a request to the laboratory for sample analyses. Information required includes:

- Name of person receiving the sample
- Laboratory sample number
- Date of sample receipt
- Sample allocation
- Analyses to be performed.

8.3 *Measurement and Analysis*

8.3.1 Water Quality Meter

YSI meters will be used to measure water quality parameters. The instrument will be calibrated daily both at the start of the sampling event and post-sampling in accordance with the manufacturers requirements. Field staff will routinely check the meter throughout the sampling event and recalibrate if necessary. A log of equipment calibration activities will be maintained with the field log.

8.3.2 Bacteria, Chlorophyll-a, TSS and BOD5 Samples

For samples collected for analysis for fecal coliform bacteria, enterococci, chlorophyll-a, TSS and BOD5 the laboratory will follow proper laboratory practices, an internal quality control program, and external quality control audits by the New York State Department of Health.

For each day of a sampling event, a field blank will be included before the first sample is collected and a trip blank will be included at the conclusion of the sampling event Field. Trip blanks will be analyzed to assess bacteriological contamination during field sampling and transport. To avoid contamination and cross-contamination of samples, sampling equipment will be rinsed with receiving water upon arrival at each sampling station, and field staff will don disposable gloves prior to initiating sample collection. At the end of each day of sampling, the sampling gear shall be rinsed thoroughly with fresh, distilled water.

One duplicate sample will be collected for each sampling day and will be analyzed separately by the laboratory. In instances where a sampling effort involves sample collection from both boat and landside (e.g. surface water wet weather and CSO sampling), a duplicate sample will be collected for each component of the sampling scope. Duplicate samples will be used to confirm the validity of the test samples by replicating the results.

The laboratory will routinely run internal system audits through the use of duplicate samples, spike samples and reference samples. Analysts will review data for acceptable ranges of precision and accuracy and have a predetermined limit for corrective action. Before data is released, it will be reviewed by the laboratory QC Director.

8.3.3 Diurnal

The instrument will be calibrated daily both at the start of the sampling event, two weeks into the one month of sampling and post-sampling in accordance with the manufacturers requirements. A log of equipment calibration activities will be maintained with the field log.

8.3.4 SOD

Two samples (original and duplicate) will be collected from each site and processed in parallel, providing two independent samples from each location. The oxygen uptake measurements will be made, over time, on each sample after the samples are returned to the lab and the overlying water is brought to saturation. Upon completion of the first set of oxygen uptake measurements, the sample and the duplicate sample will be gently aerated overnight and a second uptake measurement made on each sample.

8.3.5 Area-Velocity Flow Meter

The accuracy of the data collected using the area-velocity and customized fixed instrumentation assembly will be determined by evaluating precision and bias of measurements. Bias measures systematic error, while precision describes the scatter of multiple readings of the same measurement. Instrumentation used for the area-velocity meters and customized assembly will have documented calibrations that quantify measurement error. Logged data will be compared to spot measurements taken during equipment servicing throughout the data collection window.

8.4 *Data Validation and Usability*

Data will be submitted to the Sampling Program Manager from the laboratories as analytical reports and COC documentation. Upon receipt of the data reports, the Sampling Program Manager will perform a quality review/data validation exercise, which includes an evaluation of the following, as applicable to the analytical method/services provided:

- Field logs
- COCs
- Laboratory case narrative
- Holding times
- Blank results
- Duplicate results
- Review of data
- Identification of outliers and anomalies

If questions or concerns arise during the review process, the Sampling Program Manager will seek to address the item with the laboratory and then document any relevant information in the data summary for the FSAP. The Sampling Program Manager will discuss potential corrective actions based on the review of the laboratory results with the LTCP Leader and/or Project Manager.

9 Data Management and Reporting

Upon completion of the sampling and sample analyses, results will be compiled into a data summary. The report will include a narrative of the goals, a map of the sampling locations and data tables providing analytical results.

The Sampling Program Manager will forward the data summary to the LTCP Leader for the subject waterbody for refinement of the relevant Landside and Water Quality Models and for development of the waterbody LTCP. Limitations in the data will be noted for potential end users. Data may be presented to DEP and others in progress meetings.

The records resulting from the FSAP include: this Comprehensive FSAP and the waterbody-specific FSAP attachment; miscellaneous correspondence, field logs, laboratory analytical reports, and the data summary. Records will be maintained on the AECOM network drive and the summary report will be posted to the project SharePoint site. The data summary and the Excel data files will also be transmitted to the appropriate DEP representative.

10 Health and Safety

A site specific Health and Safety Plan (HASP) was developed by each firm that will assist in implementing a given FSAP. The HASPs covered the range of activities expected to be performed under the contract and were approved by DEP prior to execution of field sampling activities. As needed, a Job Hazard Analysis (JHA) will be developed by firms for site specific environmental health and safety concerns. Each JHA must be submitted to DEP for approval and fieldwork will not commence until it is similarly approved by DEP. Each LTCP team member firm is responsible for defining and enforcing their HASPs and JHAs for each waterbody under the LTCP project.

ATTACHMENT A

SOD Sampling and Analysis Protocol

MEASUREMENT OF SEDIMENT OXYGEN DEMAND

Background

Sediment oxygen demand (SOD) measures the depletion rate of dissolved oxygen (DO) in water overlying sediment, due primarily to microbial degradation of detrital organic matter in the sediment and potentially to aerobic respiration of infauna. The procedure described here measures declining DO concentrations in overlying water as intact, sealed, sediment cores are incubated in the laboratory under controlled environmental conditions.

Field Sampling

1. GIS coordinates and basic water-quality measurements should be taken and recorded at each sampling station before sediment cores are collected. Water-quality measurements should include water temperature, salinity, and DO concentration at 1-m below water surface, mid water, and 1-m above the bottom. Omit mid-water measurements for water depths between 2 m and 4 m. Omit surface and bottom measurements for water depths less than 2 m.
2. The number of sediment sampling locations and sediment cores depends principally on the number of cores that can be incubated and monitored effectively in the laboratory. Typically, laboratory incubation is performed for batches of 10 cores, which represent paired samples collected at 5 sampling locations.
3. Paired core tubes should be pre-labeled for each sampling location. Paired 2-L Nalgene containers should be pre-labeled similarly for collection of bottom water.
4. Collect sediment cores using approximately 4-in. I.D. acrylic core tubes by pushing the tubes into sediment by hand and/or by using a vibratory corer. The lower edge of the tubes should be beveled to ease penetration into the sediment. Insert the tube into the sediment carefully so as not to dislodge a surficial flocculent layer.
5. Place a rubber end cap across the top of the core tube after it has been inserted into the sediment. The end cap creates a vacuum that keeps the sediment sample within the tube as the tube is withdrawn slowly from the sediment. Place a second end cap across the base of the core tube as soon as it has cleared the sediment surface.
6. Core tube lengths should be 22 in., with the core sample to include approximately 14 in. of sediment and 8 in. of overlying water. Consistent sediment length is desirable but difficult to achieve. Reject and resample any cores containing less than 10 in. of sediment. Rejected sediment cores should be discarded into a bucket to keep from contaminating the sampling location. The core tubes should be rinsed clean over the bucket before being used for resampling.
7. Acceptable sediment cores should be placed and maintained upright in cooled, insulated containers to minimize sediment oxygen demand in the field.
8. Approximately 4 L of bottom water should also be collected at each sampling location and placed in cooled, insulated containers. The bottom water will be used to top off sediment cores in the laboratory and to serve as sampling "blanks" to determine biological oxygen demand (BOD) of the overlying water. When collecting the bottom water, care should be taken not to disturb and suspend surficial sediment.

Laboratory Setup

1. Sediment cores and bottom water should be transported to the laboratory for analysis as soon as possible following collection.
2. The cores should be placed upright in a holding rack that is set within a 20 °C water bath or in a controlled air environment approximating 20 °C. Be certain that the core-tube bottom caps are both sediment and water tight. The core tubes must be incubated in the dark, so it is convenient to cover the lower section of each tube with aluminum foil before placing the tube in the holding rack. The upper section can be covered with aluminum foil later.
3. Carefully top off the core tubes with bottom water from the corresponding sampling station until water level in the core tube is approximately 0.5-in. from the upper lip. Add airstones to each core tube and gently aerate the overlying water until DO approaches saturation and water temperatures equilibrate to 20 °C. Sediment cores can be left to saturate and equilibrate overnight. Do not allow the aeration to disturb the core sediment.
4. For each sampling station, paired "blanks" of bottom water should be prepared in a parallel manner to the sediment cores. Blanks can be setup in empty core tubes or using standard BOD bottles.
5. After bringing overlying water in the sediment cores to DO saturation and temperature equilibration, fit each sediment core tube with an airtight, watertight top cap. As shown in Figure 1, the top cap shall include airtight, watertight passages for a stirring paddle and a <u>pre-calibrated</u> dissolved oxygen electrode. (*N.B., The sampling ports shown in Figure 1 are not required.*) The lower section of a top cap inserts into a core tube and is sealed against the core tube interior by an o-ring. The o-ring should be lubricated very lightly with laboratory-grade silicone (e.g. "stopper") grease. Insert the top cap carefully to prevent trapping of air bubbles under the cap. Trapped air bubbles will invalidate the SOD analysis.
6. Blanks of bottom water should be set up similarly. If using BOD bottles, plastic-coated magnetic mixing bars might be more convenient than top-mounted stirring paddles.
7. As each sediment core or bottom-water blank is set up, activate the stirring paddle or mixing bar. An appropriate RPM for the sediment-core stirring paddles will mix the overlying water thoroughly without disturbing the sediment. (*Pre-testing should be conducted prior to the SOD study using representative sediment cores and adding several drops of dye to the overlying water to assess mixing.*)
8. Confirm visually that the mixing device is activated at an acceptable RPM, then cover the sediment core tube or blank completely with aluminum foil.

DO-Uptake Procedure

1. Following set up of each sediment core or bottom-water blank, record the start-up time and initial DO concentration.
2. Thereafter, measurements of DO concentration are generally taken every hour. More-active sediments might necessitate more frequent measurements and less-active sediments less-frequent measurements.

9. Incubation should continue until a cumulative DO depletion of 3 to 4 mg/L occurs. However, DO concentration should not be allowed to drop below 2 mg/L or microbial inhibition might occur. If DO concentration in a core tube or bottom-water blank drops rapidly below 2 mg/L before five (5) measurements can be collected, the core can be reaerated and the incubation restarted with more-frequent measurements.

SOD Analysis

1. For each sediment core and bottom-water blank, plot DO concentration vesus time and determine the linear-regression best fit to the data.
2. The slope of the regression line for a sediment-core (K_{sw}) is the combined DO depletion rate (mg/L-hr) due to sediment and overlying water.
3. The slope of the regression line for a bottom-water blank (K_w) is the DO depletion rate (mg/L-hr) due to overlying water only.
4. Measure and record the depth of overlying water (H_w) in each core.
5. SOD (g-m^2/d) for a cylindrical core can then be calculated as: $SOD_{20^\circ C} = (K_{sw} - K_w)H_w$.

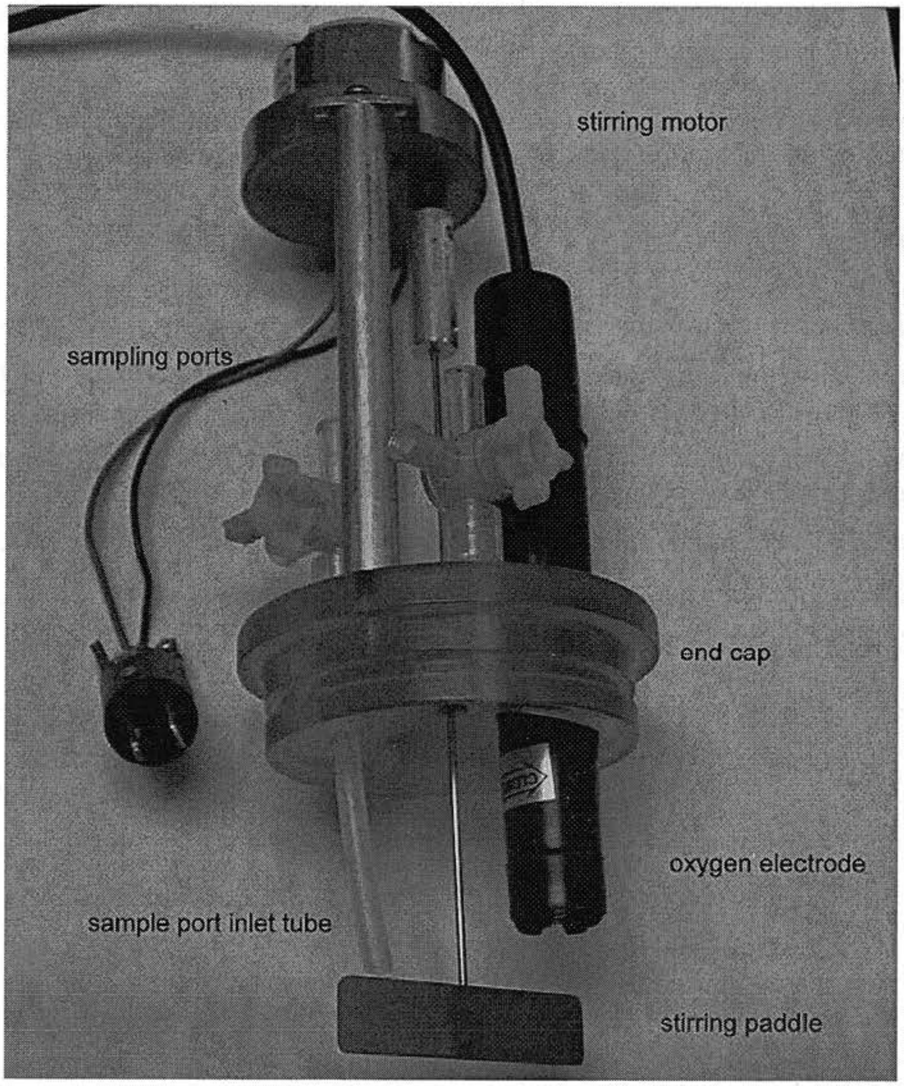

Figure 1. Example of a sediment core top cap showing stirring paddle, oxygen electrode, and o-ring groove.

ATTACHMENT B

Sample Field Log

Flushing Creek Long Term Control Plan									
Ambient Water Quality Sampling-Field Data Sheet (Boat Crew)									
DRY WEATHER SAMPLING									
Date:				Sample day 1A of 1					
Sampled By:									
Courier drop off time (military) :									
Station	Time (military)	Temp (°C)	Conductivity (mS/cm^c)	Salinity (ppt)	DO (%)	DO (mg/l)	Duplicate Taken at this Station	Depth of Sample (ft)	Depth at Station (ft)
OW1									
OW2									
OW3									
OW4									
OW5									
OW6									

Flushing Creek Long Term Control Plan									
Ambient Water Quality Sampling-Field Data Sheet (Boat Crew)									
DRY WEATHER SAMPLING									
Date:				Sample day 1B of 1					
Sampled By:									
Courier drop off time (military) :									
Station	Time (military)	Temp (◦C)	Conductivity (mS/cm^{c})	Salinity (ppt)	DO (%)	DO (mg/l)	Duplicate Taken at this Station	Depth of Sample (ft)	Depth at Station (ft)
OW1									
OW2									
OW3									
OW4									
OW5									
OW6									

ATTACHMENT C

Example Analytical Laboratory Chain of Custody Forms

QCL

1205 Industrial Blvd.
Southampton, PA 18966-0514
Phone: 215-355-3900
Fax: 215-355-7231

CHAIN OF CUSTODY

Page 1 of 1

Lab LIMS No:

Client/Acct. No. AECOM/TE0531

Address 605 3rd Ave 27th FL

City/State/Zip New York, NY10158

Phone/Fax

Client Contact

Bill to/Report to: (if different)

Sampling Site Address: (if different)

P.O. No.

QC Contact

LAB USE ONLY:

- # ___ Ascorbic/HCl Vials # ___ HCl Vials
- # ___ $Na_2S_2O_3$
- # ___ Na OH/Zn acetate pH
- # ___ HNO_3 pH
- # ___ H_2SO_4 pH
- # ___ NaOH pH
- # ___ Unpreserved
- # ___ Hcl pH
- # ___ Temp control ___ ID#

MATRIX CODES

- DW: DRINKING WATER
- GW: GROUND WATER
- WW: WASTEWATER
- SO: SOIL
- SL: SLUDGE
- OIL: OIL
- SOL: NON SOIL SOLID
- MI: MISCELLANEOUS
- X: OTHER

Field pH, Temp (C or F), DO, Cl_2, S. Cond. etc.

PROJECT

FIELD ID	Collection Date	Collection Military Time	GRAB	COMP	Matrix Code	Total	H_2SO_4	HCl	Vials	HNO_3	NaOH	ZnAc	Unpre	Bact	ANALYSIS REQUESTED	Field pH, Temp (C or F), DO, Cl_2, S. Cond. etc.
HP-014-1			X			1								X	Fecal - Entero	
HP-014-2			X			1								X		
HP-014-3			X			1								X		
HP-014-4			X			1								X		
HP-014-5			X			1								X		
HP-014-DuP			X			1								X		
HP-014-Field Blank			X			1								X		
HP-014 - Trip Blank			X			1								X		

SAMPLED BY: (Name/Company) Savin

Verbal/fax data due: ___/___/___

Hardcopy due: ___/___/___

Report Format: ☐ Standard ☐ Forms ☐ Standard + QC ☐ NJ Reduced ☐ Disk

Please call for pricing and availability on rush (<14-21 day) turnaround and on all but standard format.

Field Parameters Analyzed By:

Sig:

Date/Time:

SAMPLE CUSTODY EXCHANGES MUST BE DOCUMENTED BELOW. USE FULL LEGAL SIGNATURE, DATE AND MILITARY TIME (24 HOUR CLOCK, I.E. 8AM IS 0800, 4 PM IS 1600)

	DATE	TIME		DATE	TIME
RELINQUISHED BY SAMPLER 1			RECEIVED BY 1		
RELINQUISHED BY 2			RECEIVED BY 2		
RELINQUISHED BY 3			RECEIVED BY 3		
RELINQUISHED BY 4			RECEIVED BY 4		
RELINQUISHED BY 5			RECEIVED BY 5		

DELIVERY METHOD: ☐ QC COURIER ☐ CLIENT ☐ UPS ☐ FEDEX ☐ OTHER____

Custody Seal Number

COMMENTS:

Hazardous: yes / no

For example to aid completion, see reverse side.

FINAL REPORT

Chain Of Custody Record

Source Molecular C r a n

SHIPPING ADDRESS:
4985 SW 74th Court, Miami, FL 33155 USA
Tel: (1) 786-220-0379 Fax: (1) 786-513-2733
Email: info@sourcemolecular.com

Company Name:	
Contact Name(s):	
E-mail Address(es):	
Phone:	
Address:	
City/State/Zip:	
Country:	

Analysis Requested

Mark boxes with "X"

Sample ID	Media	Sample Date	Sample Time	# of Containers	GENERAL BACTEROIDETES ID	HUMAN 1 (HF183)	HUMAN 2 (Hum M2)	BIRD FECAL ID	DOG BACTEROIDETES ID		Quantification (Yes, No, If Positive)	Comments
A	WATER	M/D/YR	HH:MM	1	X	X	X	X	X		IF POSITIVE	
B												
C												
...												
...												
TRIP BLANK	DI WATER											
DUPLICATE	WATER											

Completed by Client:

SAMPLES DELIVERED BY SIGN: ______

SAMPLER NAME PRINT: ______

SAMPLE SITE ______

WITNESS ______

TRACKING CODE ______

Completed by Source Molecular:

SAMPLES RECEIVED BY ______

RECEIVED DATE/TIME ______

TEMPERATURE ______

CONDITION ______

SIGNATURE ______